



Original communication

Frequency of intracranial injury in cadavers with head trauma with and without scalp injury in Tehran

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ARTICLE INFO

Article history:

Received 25 May 2014

Received in revised form

18 August 2014

Accepted 17 September 2014

Available online 2 October 2014

Keywords:

Head trauma

Intracranial hemorrhage

Brain injury

Scalp injury

ABSTRACT

Traumatic brain injury is a major cause of morbidity, disability and mortality in patients with head injury. The aim of this study was to elucidate the frequency of intracranial injury in cadavers with head trauma with and without scalp injury in Tehran.

In this analytical cross-sectional study, we investigated 187 cadavers who died due to head trauma in motor vehicle accident or after falling in Tehran from November 2013 to February 2014. Age, sex, mechanism of trauma, scalp injury, sub-scalp bruising, skull fracture, hemorrhage including subdural hemorrhage (SDH), epidural hemorrhage (EDH), subarachnoid hemorrhage (SAH) and contusion were recorded from examination and autopsy.

One hundred and eighty seven cadavers (165 (88.2%) male and 22 (11.8%) female) with head injury with the mean age of 36.14 years (SD = 15) were recruited in this study. Mechanism of trauma was motor vehicle accident in 147 (78.6%) cadavers and falling in 40 (21.4%) cadavers. One hundred and fifty eight (84.5%) had SDH, 44 (23.5%) had EDH, 162 (86.6%) had SAH and 139 (74.3%) had contusion. Hemorrhage was seen in 132 (93%) cadavers who had scalp injury and 36 (80%) cadavers who did not have scalp injury ($p = 0.01$).

Overall, 168 (89.8%) cadavers had hemorrhage and 139 (74.3%) had contusion. There was a significant correlation between intracranial injuries and scalp injury ($p < 0.05$). There was not a significant correlation between EDH and scalp injury ($p = 0.52$). Consequently, in patients with head trauma, complete examination should be performed but absence of findings in examination cannot exclude intracranial injury.

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1. Introduction

Traumatic brain injury (TBI) is a common cause of death accounting for 18 per 100,000 per year in the United States. These injuries are caused by motor vehicle accidents, falls or assaults of various types.¹

Head injury is a nonspecific and antiquated term, which encompasses clinically evident external injuries to the face, scalp and calvarium. These injuries include lacerations, contusions, abrasions and fractures but they are not necessarily associated with TBI. Injury is more properly defined in TBI, which is known as an alteration in brain function manifesting as confusion, altered level of consciousness, seizure, coma and focal sensory or motor neurologic deficit. These may arise from blunt or penetrating forces on the head. In mild TBI, subtle behavioral and neuropsychological changes may be the only symptoms.²

Hemorrhages are clues to the site of tearing where energy has passed. Traumatic intracranial central nervous system hemorrhages occur in epidural space, subdural space, subarachnoid space, brain tissue (intra-cerebral bleeding) and cerebral ventricles.³

TBI is the major cause of disability, morbidity and mortality among patients with head injury and is responsible for a significant proportion of all traumatic deaths in the U.S.⁴

Iran carries one of the highest rates of motor vehicle accidents in the world. This study was conducted to elucidate the frequency of intracranial injury in patients with head trauma who may be presented with or without scalp injury in Tehran.

2. Methods and materials

This was an analytical cross-sectional study in which 187 cadavers, who died because of head trauma due to motor vehicle accident or falling, were recruited. These cadavers were referred to

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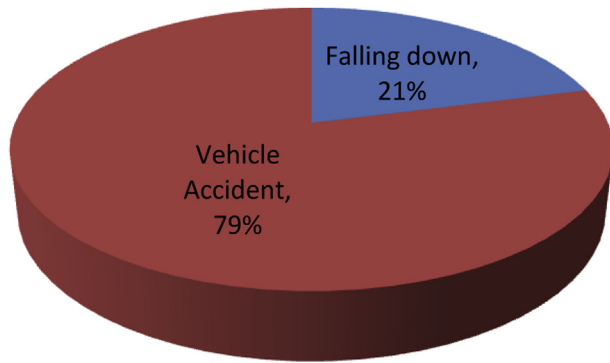


Fig. 1. Distribution of cadavers according to the mechanism of injury.

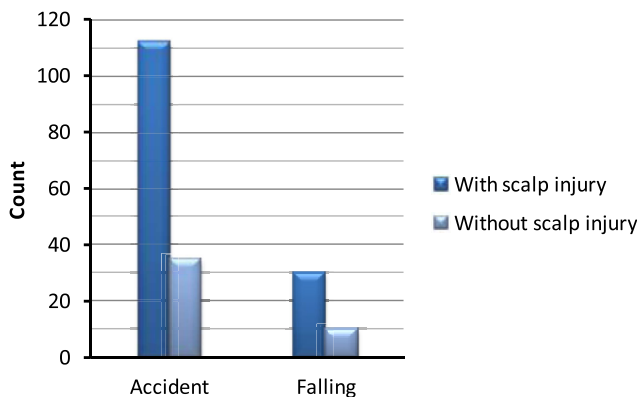


Fig. 2. Mechanism of injury with and without scalp injury.

the Forensic Medicine Organization in Tehran from November 2013 to February 2014.

Demographic data were collected, which included age and sex, along with other variables, namely, mechanism of trauma, scalp injury, scalp abrasion, scalp laceration, sub skull bruising and its severity, skull fracture, skull base fracture and hemorrhage. Hemorrhage was further subdivided in other categories including subdural hemorrhage (SDH), epidural hemorrhage (EDH), subarachnoid hemorrhage (SAH) and contusion. These data were collected from examination and autopsy of cadavers.

Data were entered and analyzed using SPSS program version 16. Mean (standard deviation (SD)) and frequency were used for descriptive variables and Chi square test was used for comparing qualitative variables.

All provisions of the Helsinki Declaration were observed in this study.

3. Results

This study recruited 187 cadavers with head injury. Males constituted 165 (88.2%) and females constitutes 22 (11.8%) cadavers

Table 1
Comparison of contusion between cadavers with and without scalp injury.

			Contusion		Total	P value	
			Yes	No			
Scalp injury	Yes	Count (%)	113 (79.6%)	29 (20.4%)	142 (100.0%)	0.004	
		% of Total	60.4%	15.5%			75.9%
	No	Count (%)	26 (57.8%)	19 (42.2%)			45 (100.0%)
		% of Total	13.9%	10.2%			
Total		Count (%)	139 (74.3%)	48 (25.7%)	187 (100.0%)		

Table 2
Comparison of SDH between cadavers with and without scalp injury.

			SDH		Total	P value
			Yes	No		
Scalp injury	Yes	Count (%)	125 (88.0%)	17 (12.0%)	142 (100.0%)	0.01
		% of Total	66.8%	9.1%	75.9%	
	No	Count (%)	33 (73.3%)	12 (26.7%)	45 (100.0%)	
		% of Total	17.6%	6.4%	24.1%	
Total		Count (%)	158 (84.5%)	29 (15.5%)	187 (100.0%)	

with the mean age of 36.14 (SD = 15.98). The mean age was 36.62 (SD = 16.04) in males and 32.50 (SD = 15.40) in females ($p = 0.423$). Scalp injury was found in 142 (75.9%) cadavers.

Mechanism of trauma was motor vehicle accident in 147 (78.6%) cadavers and falling in 40 (21.4%) cadavers (Fig. 1). Assaults were excluded during that time. Scalp injury was found in 112 (76.2%) cases with motor vehicle accident injury and 30 (75%) cases of falling (Fig. 2). Scalp abrasion, scalp laceration and skull fracture were seen in 122 (65.2%), 102 (54.5%) and 121 (64.7%) cadavers, respectively. Sub-scalp bruising was observed in 176 (94.1%) cadavers, of whom, 57 (30.5%) had mild, 119 (63.6%) had severe bruising and 11 (5.9%) were missed.

Hemorrhage was observed in 168 (89.8%) cadavers distributing as 158 (84.5%) with SDH, 44 (23.5%) with EDH, 162 (86.6%) with SAH and 139 (74.3%) with contusion. Contusion was seen in 113 (79.6%) cadavers with scalp injury and 26 (57.8%) without scalp injury, which reaches the level of statistical significance ($p = 0.04$) (Table 1). SDH was seen in 125 (88%) cadavers with scalp injury and 33 (73.3%) cadavers without scalp injury, which also reaches statistical significance ($p = 0.01$) (Table 2).

EDH was seen in 35 (24.6%) cadavers with scalp injury and 9 (20%) cadavers without scalp injury ($p = 0.52$) (Table 3). SAH was observed in 128 (90.1%) cadavers with scalp injury and 34 (75.6%) cadavers without scalp injury ($p = 0.01$) (Table 4). Hemorrhage was seen in 132 (93%) cadavers with scalp injury and 36 (80%) cadavers without scalp injury ($p = 0.01$). Finally, skull fracture was identified in 105 (73.9%) cadavers with scalp injury and 16 (35.6%) cadavers without scalp injury ($p < 0.001$) (Table 5).

4. Discussion

In our study, male-to-female ratio was 7.4 to 1 (mean age 36.14 years (SD = 15.98)) that shows a much higher rate of trauma in men

Table 3
Comparison of EDH between cadavers with and without scalp injury.

			EDH		Total	P value
			Yes	No		
Scalp injury	Yes	Count (%)	35 (24.6%)	107 (75.4%)	142 (100.0%)	0.52
		% of Total	18.7%	57.2%	75.9%	
	No	Count (%)	9 (20%)	36 (80%)	45 (100.0%)	
		% of Total	4.8%	19.3%	24.1%	
Total		Count (%)	44 (23.5%)	143 (76.5%)	187 (100.0%)	

Table 4
Comparison of SAH between cadavers with and without scalp injury.

			SAH		Total	P value
			Yes	No		
Scalp injury	Yes	Count (%)	128 (90.1%)	14 (9.9%)	142 (100.0%)	0.01
		% of Total	68.4%	7.5%	75.9%	
	No	Count (%)	34 (75.6%)	11 (24.4%)	45 (100.0%)	
		% of Total	18.2%	5.9%	24.1%	
Total		Count (%)	162 (86.6%)	25 (13.4%)	187 (100.0%)	

Table 5
Comparison of skull fracture between cadavers with and without scalp injury.

			Skull fracture		Total	P value
			Yes	No		
Scalp injury	Yes	Count (%)	105 (73.9%)	37 (26.1%)	142 (100.0%)	<0.001
		% of Total	56.1%	19.8%	75.9%	
	No	Count (%)	16 (35.6%)	29 (64.4%)	45 (100.0%)	
		% of Total	8.6%	15.5%	24.1%	
Total		Count (%)	121 (64.7%)	66 (35.3%)	187 (100.0%)	

while the mean age of victims are almost the same in our country without a significant difference. Vehicle accident was the most common cause of head trauma in our study. In a study in China,⁵ which was done on patients with head trauma between 1983 and 1986, frequency of head trauma due to accident was 31.7% and constituted the most common cause of trauma. Although, the most common cause of head trauma in both studies is vehicle accident, our figure outnumbers the study from China, which once again highlights the high rate of motor vehicle accidents in our country (78.6% in our study and 31.7% in the study from China). The roads in our country (Iran) are not with accordance to international standard. The majority of people in our country do not use restrain system correctly during usage of motor vehicles; also most of motorcycle drivers do not wear standard helmet which can lead to severe head trauma in motor accidents. In our study, 168 (89.8%) cadavers with hemorrhage were distributed as 132 (79%) with scalp injury and 36 (21%) without scalp injury.

Kim et al. studied the relationship between type and size of scalp injury and intracranial injury among patients who visited the emergency room because of head trauma.⁶ They studied 193 patients with head trauma (obvious external injury or based on reports of witnesses to the accident) and found scalp bleeding in 126 (65.2%) patients and no scalp bleeding in 67 (34.8%). Only nine patients with scalp bleeding had intracranial injury while seventeen patients without scalp bleeding had intracranial injuries ($p = 0.001$). They concluded that scalp bleeding is not reliable but those with 2–5 cm scalp swelling merit accurate and careful examination including brain CT imaging.

Stein et al. aimed to assess delayed and progressive brain injury in children and adolescents with head trauma.⁷ They performed serial CT scans on 351 children and adolescents with serious closed-head injury. Delayed or progressive lesions were encountered in 145 (41%) patients. This study concluded that serial CT scans provide a reliable means of diagnosing and following the progress of delayed cerebral injury in the pediatric population.

In a study conducted by Adams,⁸ 635 cadavers with head trauma were evaluated. EDH was seen in 10% and SDH was seen 18% of cadavers. Our study found these rates to be 23.5% and 84.5%, respectively, which are evidently higher, especially for SDH, in our study.

According to Knight's Forensic Pathology, frequency of skull fracture in EDH is 85%.⁹ This rate is 90–95% in Dimaio.³ In our study, frequency of skull fracture in EDH was 77%; also skull fracture was identified in 73.9% of cadavers with scalp injury and 35.6% of cadavers without scalp injury.

Based on a study by Menon and Rajeev,¹⁰ among intracranial hemorrhages, SDH and SAH constitute 52.63% and 27.27% of cases, respectively. Contusions and lacerations of brain were found equally in 35% of cases. These values are higher in our study (84.5%, 86.6% and 74.3% respectively).

5. Conclusion

Overall, 168 (89.8%) cadavers had hemorrhage, 158 (84.5%) had SDH, 44 (23.5%) had EDH, 162 (86.6%) had SAH and 139 (74.3%) had contusion. There was a significant correlation between intracranial injury and scalp injury ($p < 0.05$). EDH and scalp injury were not significantly related. Therefore, in head trauma, intracranial injury is roughly associated with scalp injury and diagnostic imaging such as brain CT scan and MRI must be considered. In cases with head trauma, external examination should be performed, but absence of findings in external examination does not exclude intracranial injury.

Conflict of interest
None declared.

Funding
None declared.

Ethical approval
None declared.

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